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LAND CLASSIFICATION IN A CARIBBEAN LAND IMPROVEMENT PROGRAM 1/

By R. D. Hockensmith 2/

An understanding of the land is a basic factor in formulating and carrying out a complete land improvement program in the Caribbean Area. Before specific plans for developing, improving and protecting the land resources can be intelligently worked out, basic information of a scientific nature must be obtained, classified, and interpreted.

This task may for convenience be looked upon as consisting of three activities, as follows:

- (1) Soil surveys
- (2) Land-capability surveys and classification
- (3) Economic land use classification

My remarks will deal primarily with item (2) on land-capability surveys and the classification of land according to its capability. The first and third items are to be discussed by other speakers at this Conference.

In the land-capability classification many land characteristics in addition to the soil are considered. Some of these additional characteristics are slope, erosion, overflow hazards, stoniness, drainage, salinity, and climate. In classifying the land, each land characteristic is considered in relation to others.

Before land can be classified, the facts about land must be obtained in the field. This is done by skilled soil scientists. Here is the usual procedure a soil scientist follows:

He walks over the ground and observes the lay of the land. He bores or digs numerous holes deep enough to examine the topsoil and subsoil. Wherever necessary he bores deeper to see what is under the subsoil. He observes texture, color, and thickness of the topsoil, nature and thickness of the subsoil, depth of useful soil material, and other characteristics. He estimates the permeability of subsoil and substratum, capacity to hold available moisture, and often the inherent fertility. He measures or estimates the soil reaction if differences occur in the area where he is working. He notes in so far as he can the presence of salt accumulations, degree of wetness, and existence of overflow hazards. He measures the steepness of slope. He observes the degree of soil erosion. He notes also whether the land is used for crops, pasture or woodland. He records these and any other significant land facts on a base map, which is usually an aerial photograph of sufficiently large scale to show clearly the significant land separations.

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- 1/ Paper presented at Caribbean Soils Conference, Puerto Rico, March 30-April 8, 1950.
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The land characteristics most often mapped in the land-capability surveys are listed in the Guide for Soil Conservation Surveys, processed by the Soil Conservation Service, U. S. Department of Agriculture, May 1948.

Land is Classified

A land-capability classification is the work of a group of specialists. A man trained in soil science maps the land facts as has just been described. The same man or another determines significant features of the vegetation. The combined judgment of several persons, including agronomists, engineers, foresters, range men, biologists, soil scientists, and soil conservationists who are experienced in farm or ranch conservation planning, is utilized in the process of classifying land according to its capability. These specialists consult with practical farmers or ranchers and study the results of experimental work. They consider the climate of the area. The resulting land-capability classification represents the combined opinions obtained. It is an interpretation of available facts, especially of the way land characteristics affect physical capability of the land for cultivation, grazing, forestry, and wildlife.

As a rule, the same technical people with the help of practical farmers also work out recommendations about: (1) How each kind of land may be used safely; and (2) the practices needed on each kind of land to maintain and improve it under the common safe uses.

Both the classification and the recommendations are made by joining land facts with research findings, technical information, and practical farm facts for convenient use. The purpose in writing the recommendations (technical guide) is to set down in convenient form the right combination of uses and practices that suits best each particular kind of land. The technical guide is an aid in making full use of the land's productive capacity without waste or impairment.

The Classification Scheme

The group that is to classify land capability can begin work soon after the soil scientist has mapped enough land to know the principal soils, slopes, and other physical land conditions. One necessary step is to group the land-mapping units into land-capability units.

Each land-capability unit consists of the land within specified limits of soil, slope, degree of erosion, and other physical land characteristics. Land in a land-capability unit is essentially uniform with respect to physical features, including climate, that affects the crops or other plants that can be grown, and the responses of crops or other vegetation to management. All the land in a land-capability unit has about the same susceptibility to wind or water erosion under the same kind of cover. Essentially similar cropping systems or other land-management systems are applicable throughout the unit. Land-capability units are the physical land-treatment units as far as permanent, mappable land features are concerned. Each one has nearly uniform use possibilities and conservation needs. A land-capability unit may consist of a single land-mapping unit or of several.

Land-capability units are the units of land-capability classification. They are grouped in successively broader categories where such grouping serves a useful purpose: Into land-capability subclasses, each of which includes land having about the same kind and degree of permanent limitations; then into the eight land-capability classes, according to the degree of permanent limitations; and finally into the two major divisions, which are land suited for cultivation and land not suited for cultivation. The resulting classification is helpful in selecting land uses that are safe from the conservation standpoint and adaptable to the land; in selecting and applying an effective combination of soil conservation practices; and in making all necessary land-management decisions.

A farmer or rancher is concerned primarily with the land-capability units that make up his land. They are the practical land-management groups determined by permanent physical land characteristics. He is usually interested also in the eight land-capability classes. They are especially useful to show quickly the safe land uses and the approximate degree of difficulty involved in safe management. Subclasses, which are intermediate groupings between the eight classes and the specific units, are sometimes useful to show in a general way the suitable land use and the kind of management and conservation needed. A person concerned with the entire scheme for classifying land will want to examine all the categories in the classification scheme. Probably we can see the whole scheme easily if we look first at the most general category. The most general step in the classification is a separation of land suited for cultivation (from a physical standpoint) from that not suited.

Suitability for Cultivation

Cultivation is used broadly throughout this paper to include all culture that involves tillage of the soil every year or in the case of certain crops every two or three years. The distinction between land suited and land not suited for cultivation, which is required as the most general step in the classification, requires certain assumptions. These assumptions also apply in the separation of land according to degree of suitability for cultivation, grazing or forestry in the eight land-capability classes. The principal assumptions in this connection are:

1. Suitability for cultivation includes suitability for use of machinery that is common in a given country or territory for such operations as tillage and harvesting.
2. Suitability for cultivation, grazing, or forestry is judged in relation to safe use of land; that is, to management that permits use of the land without significant permanent damage.
3. Suitability for cultivation, grazing, or forestry includes an expected return greater than the labor, materials, and other inputs needed for such use. Although the returns cannot be evaluated for this purpose in strictly quantitative terms, the expected level as a rule is correlated with one or more of the mappable land characteristics that are used directly in differentiating land-capability units.

4. Characteristics that make land difficult to manage, such as heavy texture, are significant in the land-capability classification as well as those that affect land permanence.

The classification made under these assumptions and according to the principles stated in this paper is one that applies in a practical way to the land-use situation in the United States in the middle part of the twentieth century. In another country or territory at the same time, or in this country at some future time, different assumptions might be required to give a classification that is practical and workable.

Land suited for cultivation from a physical standpoint under these assumptions is workable, not too steep, not too wet, and not too severely limited by climate or other factors. Wherever the limitation of an arid climate is removed by irrigation, however, the land is classified according to its suitability for cultivation, grazing, or forestry as determined by the factors other than climate. Limiting values of the different factors cannot be set up uniformly from place to place because the significant relation is that of the combined physical land factors to safe, long-time land use. In some places, for example, a slope of ten percent is too steep for cultivation. Elsewhere, in a different environment, slopes of twenty percent or more can be cultivated safely.

Any one or more of the physical land factors, including climate, can limit land so much that it is not suited for cultivation. In classifying land capability, two questions are considered. One is the degree to which the risks of water erosion, wind erosion, or other land damage limit the chances of safe, long-time land use. The other is the limitation of practicable land use by such factors as climatic hazards not correctible by irrigation, soil limitations of tight subsoil or shallow depth, stoniness that interferes with cultivating, or other inherent, permanent limitations of the land.

Most of the land not suited for cultivation under these specifications is suited for and will produce some form of permanent vegetation.

Eight Land-Capability Classes

In the second highest category of the classification, each of the two major subdivisions contains four land-capability classes. These eight land-capability classes give a simple land classification that is useful for many purposes. The eight classes, however, are too general for many specific recommendations about management and treatment of land. The eight classes are distinguished from each other according to the degree of inherent, permanent limitations or risks involved in land use. Land in each class is distinguished by a particular set of physical characteristics. Limits of the eight classes are determined by the degree to which the land characteristics are limitations to land use or land permanence. Land-capability classes are shown by standard colors on farm maps and in publications.

Subclasses and Units

Subclasses are convenient groupings of the land-capability units within one land-capability class. A land-capability class is determined by the

degree of the total limitations in land use and risks or hazards to land permanence. Within one land-capability class the subclasses are determined by the kind of limitation. For example, within class III land, suited for cultivation but subject to severe limitations or hazards, we have sloping land subject to water erosion, naturally wet land that produces crops only if drains are maintained, and several other subclasses. Each of these is class III land, subject to a different kind of limitation.

On many small areas such as a single farm the subclass category need not be used. The soil conservationist working with a farmer generally prefers to designate the land-capability units, and the land-capability class to which each unit belongs. Thus the land operator sees directly the land characteristics and their meaning in terms of land limitations. Whenever the area considered is diverse enough to take in two or more kinds of limitations within one land-capability class, an arrangement by subclasses is helpful for many purposes. Subclasses are useful, for example, in estimating quantities of conservation practices needed. The conservation needs of class III flat, artificially drained land are very different from those of moderately sloping class III land subject to water erosion. Subclasses are generally more useful in dealing with land information over a broad, diverse area than in dealing with a single farm or a small area.

An outline of the entire scheme of classification is given in Table 1.

The classification is one of land capability in a broad sense. The objects classified are land-capability units, which are defined as essentially uniform in permanent physical characteristics. The physical characteristics of a land-capability unit include kind of soil, slope, degree of erosion, climax vegetation, climate, and any other characteristics that are associated with hazards to crops or land, such as periodic overflows. If all are favorable and none acts to limit land use or endanger land permanence, the land has broad capability. One or more limiting factors such as slope, shallow soil, wetness or subhumid climate, make the land less capable for all-around use.

Land-Capability Classes

The eight land-capability classes are the members of the second most general category in the classification scheme. These classes of land differ from each other because of their permanent physical land features that limit land use or impose risks of erosion or other damage.

The classes range from class I to class VIII inclusive. Class I contains the most widely adaptable land, which can be farmed easily. The other classes through class VIII are characterized by successively greater degrees of permanent limitations.

Land suited for cultivation

CLASS I. Land subject to no or very slight permanent limitations in use or risks of damage because of permanent land characteristics: very good land that can be cultivated safely with ordinary good farming methods. It is nearly level land with deep, productive, easily worked soils, and is not subject to more than slight water or wind erosion. It is well drained

and is not subject to damaging overflows. Class I land is productive cropland that is suited for intensive cropping use, such as production of corn and other intertilled crops.

Class I land used for crops, like all cropland, needs practices to maintain soil fertility and soil structure. Such practices often involve use of fertilizers and lime, cover and green-manure crops, crop residues, and crop rotations.

CLASS II. Land subject to moderate limitations in use, or moderate risks of damage, because of permanent land characteristics; good land that can be cultivated with easily applied special practices. The limitations of different kinds of class II land include: (1) Gentle slopes; (2) moderate susceptibility to erosion; (3) soils of only moderate depth; (4) somewhat unfavorable texture and workability; (5) moderate alkalinity or salinity, easily correctible but likely to recur; (6) occasional moderate overflows; or (7) moderate wetness correctible by drainage but existing permanently as a land limitation. These are examples; the list probably is not complete. Each of these limitations requires attention on the part of the land operator. The limitation sometimes gives the farmer less latitude in choice of crops or of management methods; or requires special practices such as soil conserving rotations, water-control devices, or tillage methods, to name only a few of the many possibilities.

Land subject to permanent limitations or risks of damage ordinarily needs a combination of practices. For example, the class II land that consists of gently sloping deep soils subject to moderate erosion probably needs several of the following practices: Terracing, strip cropping, contour tillage, crop rotations that include grasses or legumes, vegetated water-disposal areas, cover or green-manure crops, stubble mulching, fertilizers, manure, and lime. The exact combination of measures will vary from place to place. It depends on the characteristics of the land, including the climate; and also on the system of farming that the farmer wants to follow.

CLASS III. Land subject to severe limitations in use for cropland, or severe risks of damage, because of permanent land characteristics; moderately good land that can be used regularly for crops in a good rotation but needs intensive treatment. Limitations of different kinds of class III land include the following; the list probably is not complete: (1) Moderately steep slope; (2) high susceptibility to erosion; (3) moderate overflow hazard; (4) slow or very slow subsoil permeability; (5) excessive wetness and a continuing hazard of water-logging; (6) shallow depth to bedrock, hardpan, or claypan; (7) sandy, very sandy, or gravelly soil with low moisture capacity; or (8) low inherent fertility. The foregoing list is one of general indicators, not specific guides. Land-capability significance of the factors listed varies somewhat according to climate and other influences.

Class III land is more limited by its permanent natural characteristics or is subject to greater risks than class II land. Limitations of some class III land restrict the choice of crops or the timing of such operations as planting and tillage.

CLASS IV. Land subject to very severe permanent limitations or hazards in use for cropland; fairly good land that is best maintained in perennial vegetation but can be cultivated occasionally or in a limited way if handled with great care. Its cropping use is limited by natural permanent features such as slope, erosion, unfavorable soil characteristics, or adverse climate. Much class IV land in the humid regions is suited for occasional cultivation. On it the farmer can safely use a long rotation of a grain crop every 5 or 6 years, followed by several years of hay or pasture. Some of the nearly level imperfectly drained land classified as IV is not subject to erosion but is unsuitable for intertilled crops because of the time required for the soil to dry out in the spring and because of its low productivity when in these crops. Choice of crops is often limited also. Some class IV land is suited only for certain specialized crops.

Land not suited for cultivation

CLASS V. Land not suited for cultivation but suited for permanent vegetation, grazing or forestry, with few or no permanent limitations and not more than slight hazards. Cultivation is not feasible because of one or more factors such as permanent wetness, stones, or some other limitation. The land is nearly level and not subject to wind or water erosion. Grazing use or forestry use is governed by the requirements for maintaining good vegetation. Certain range-management or woodland-management practices such as stocking within carrying capacity and control of burning are always needed to obtain satisfactory production. Class V land on which vegetation has become temporarily depleted through misuse may require moderate or even severe restrictions in grazing or woodland use for a period of time to improve the vegetation. The land, however, is not damaged easily.

CLASS VI. Land subject to moderate permanent limitations or moderate hazards under grazing or forestry use; not suited for cultivation. It is too steep, subject to erosion, shallow, wet, or dry, or it is otherwise not suited for cultivation, but with careful management is suited for grazing or forestry. Some class VI land can be tilled just enough to establish pastures; some can be used safely for tree crops if permanent cover is maintained. The restrictions commonly needed on class VI range land to maintain the soil are chiefly regulation of grazing within the carrying capacity, deferred grazing to permit growth of grass in the spring, and rotation of grazing to permit the grass to recover and form seed. Fencing, careful location of watering places, salting and herding are some of the practices necessary to use the land properly. Gullies should be controlled by diversion of water, planting, or whatever measures are necessary. Contour furrows, ridges, diversions, or water spreaders are useful on some sites to check or divert water and thereby increase the growth of grass.

Land of class VI is capable of producing forage or woodland products under moderate restrictions. If, however, the vegetation has been depleted by mismanagement, severe restrictions in use for a few years probably are needed to permit recovery of vegetation. An example of such temporary severe restrictions would be exclusion of livestock from overgrazed class VI range land until the desirable vegetation is restored.

Class VI land as a rule is either steeper or more subject to wind erosion than class IV land. It must not be too severely eroded, however, to prevent safe use with moderate restrictions for grazing or woodland.

Pastures in humid regions on class VI land generally need liberal fertilization and careful regulation of grazing, and many of them need liming and reseeding.

CLASS VII. Land subject to severe permanent limitations or severe hazards under grazing or forestry use; not suited for cultivation. It is very steep, eroded, rough, shallow, dry, or swampy, or it is otherwise limited, but can be used for grazing or forestry if handled with great care. Owing to these adverse land characteristics that severely limit the growth or utilization of vegetation, the land is generally fair or poor for grazing or forestry. Depletion of cover on rough, erodible class VII land leads to more rapid damage than on class VI land that has similar but less extreme limitations. Structures such as contour furrows, ridges, and water spreaders for the most part cannot be used on class VII range land because of steep slopes, shallow soils, or other unfavorable factors.

Most class VII land in humid regions is recommended for woodland rather than for pasture. Practices recommended for woodland usually include exclusion of livestock, prevention of fire, selection of trees for cutting, and careful harvesting methods. Most of the severely gullied land in humid areas is class VII land that should be planted to trees.

CLASS VIII. Land that has some limitation that makes it unfit for cultivation, grazing, or forestry. It is suited for wildlife, recreation, or watershed uses. It includes such areas as marshes, deserts, badlands, deep gullies of the caving type, high mountain land, barren land, and extremely steep or stony land. Class VIII land often occurs in small areas, such as roadsides or ditch banks, that cannot be shown on the maps made for farm planning. Protection is necessary for some of these areas.

Permanent Land Limitations

Land factors used in the land-capability classification are those which limit land use or impose risks of erosion or other damage. Only permanent land features affect the classification. Slope, for example, is one factor that limits safe land use. Arid climate is another. Soil limitations, such as textures too fine or too coarse, or a shallow depth of useful soil material, are other examples. Temporary features, such as present vegetation, do not affect the land-capability classification. Land in any one of the classes suited for cultivation may be covered at present with trees, stumps, or brush, or may be without cover. The soil may be depleted or in poor structural condition. Temporary limitations, of course, are of extreme importance in making immediate land-management decisions, although they do not affect the land-capability classification.

Restrictions in grazing use are often mentioned in management of ranges and pastures. Temporary restrictions in number of livestock in order to improve condition of vegetation are not considered in the land-capability classification. After a permanent range has been brought to excellent condition, however, the restrictions needed to keep it there would be considered in the classification.

Use of Land-Capability Maps

The farmer has in his land-capability map a written record of the land conditions on his farm. With a knowledge of land conditions and land capability, he has information to help him make production adjustments. His very good, nearly level land can be used most often for crops. His steeper, more erodible, or other less desirable land can be used for hay, pasture, shrubs, or trees. Often class III land that is moderately steep and subject to erosion will give better returns from grasses or legumes than from annual crops.




Capability of the land affords a sound basis for agricultural credit. Land farmed with regard for its inherent limitations is a better credit risk than land farmed beyond its capability. Lending institutions can encourage conservation and discourage misuse of land.

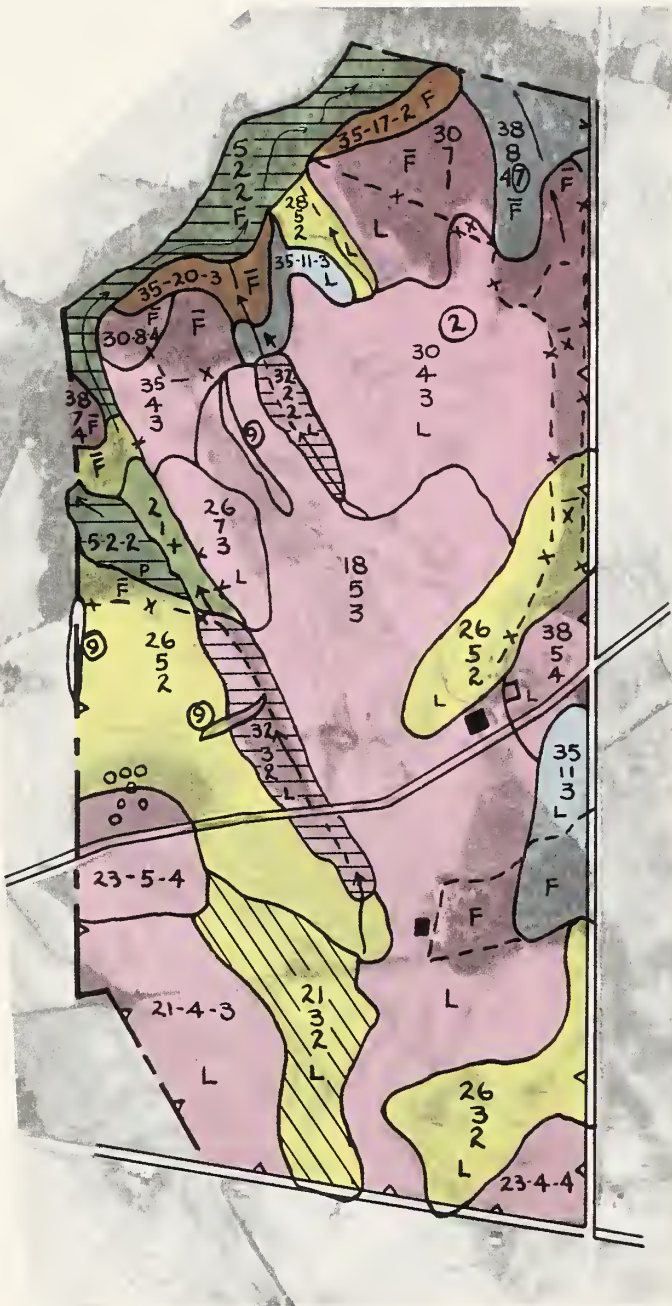
Capability of land is of interest to many public agencies and to business concerns. Extension of roads, electric lines, and other improvements often can be planned with greatest efficiency if information about capability of the land is available. Often tax assessments can be guided by the nature of the land and its capability classification. Usually for such purposes information is needed about land-capability units or at least about the subclasses within the eight land-capability classes.

* * * * *

Table 1.

Outline of the land-capability classification

Major land use suitability (Broad grouping of limitations)	Land-capability class (Degree of limitations)		Land-capability subclass (Grouping of land-capability units according to kind of limitation. This table shows examples only.)	Land-capability unit (Land - management groups based on permanent physical characteristics. This table shows examples only.)
Suited for cultivation	I	Few limitations. Wide latitude for each use. Very good land from every standpoint.		
	II	Moderate limitations or risks of damage. Good land from all-around standpoint.		
	III	Severe limitations or risks of damage. Regular cultivation possible if limitations are observed.		Moderately sloping, slightly acid soils on limestone.
				Moderately sloping, highly acid soils on sandstone or shale.
				
	IV	Very severe limitations. Suited for occasional cultivation or for some kind of limited cultivation.		
Not suited for cultivation	V	Not suited for cultivation because of wetness, stones, overflows, etc. Few limitations for grazing or forestry use.	Grouping of sites according to kind of limitation.	Sites significant in management of ranges, pastures, forests, etc.
	VI	Too steep, stony, arid, wet, etc., for cultivation. Moderate limitations for grazing or forestry.		
	VII	Very steep, rough, arid, wet, etc. Severe limitations for grazing or forestry.		
	VIII	Extremely rough, arid, swampy, etc. Not suited for cultivation, grazing, or forestry. Suited for wildlife, watersheds, or recreation.		



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE SOUTHEASTERN REGION
H. H. Bennett, Chief T. S. Buie, Regional Conservator

LAND-CAPABILITY MAP

Jonah and (2)
FOR Elijah Blackwell FARM NO. SC-SCD-3-C-1110
DATE 7-22-48 PHOTO SHEET NOS. OW-3-109

Class I. Well-drained productive bottom land.
(2-1-*)

Class IIE. Smooth to moderately sloping gray sandy land with slight erosion. If cultivated, needs terracing, outlets, and a strip rotation with half the area in close-growing crops such as small grain and lespedeza. Needs additional potash and organic matter for best crop production. (26-3-2, 26-5-2, 28-5-2)

Class IIE. Smooth to moderately sloping brownish-red sandy clay land. If cultivated, needs terracing, outlets, and a crop rotation with half the area in close-growing crops such as small grain and lespedeza. (21-3-2)

Class IIIIE. Sloping brownish-red sandy clay land with slight to moderate erosion. If cultivated, needs two-thirds of the area in close-growing crops such as small grain and lespedeza. (18-5-3, 40-5-3, 21-4-3, etc.)

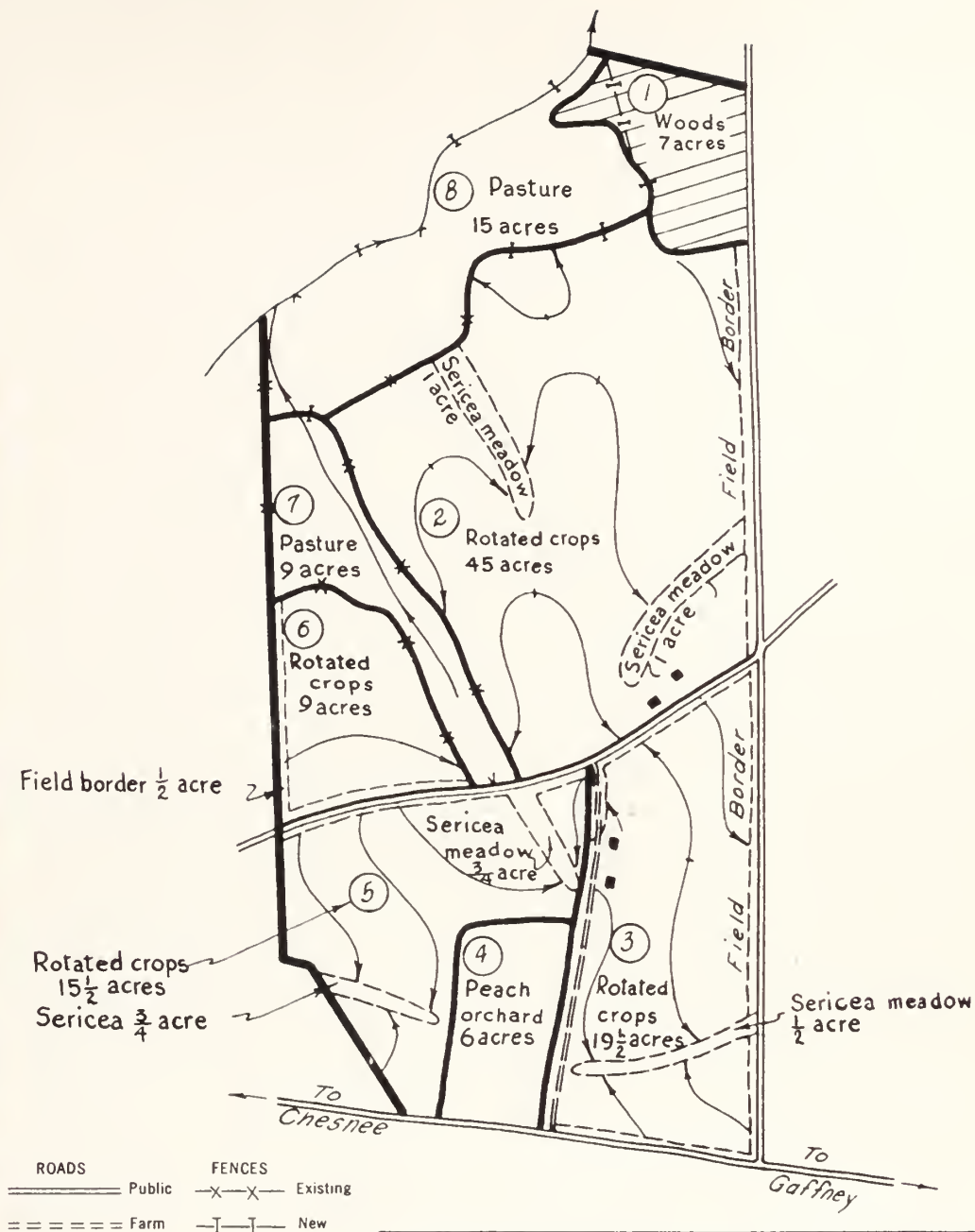
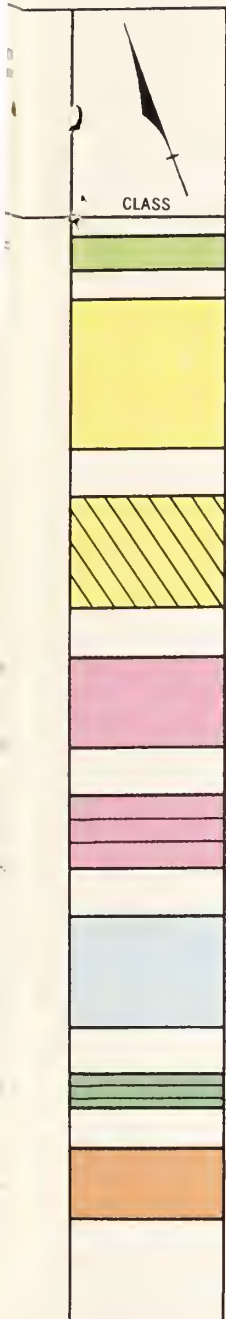
Class IIIA. Level leached fine sandy loam with very heavy dense subsoil. Subject to standing water during wet spells. Good pasture land; drainage recommended. (32-3-2)

Class IVE. Moderately steep brownish-red sandy clay land with slight erosion or smooth sloping red sandy clay land with serious erosion. Recommended for kudzu, sericea, or pasture. Can be used for small grain and lespedeza. (35-11-3, 38-8-4)

Class VA. Level wet land with poor subsoil drainage. Best use: pasture. (5-2-2)

Class VIE. Steep brownish-red sandy clay land with slight erosion. Best use: kudzu, sericea, pasture, or woodland. Too steep for cultivated crops. (35-20-3, 35-17-2)

0 500' 1000' 1320'



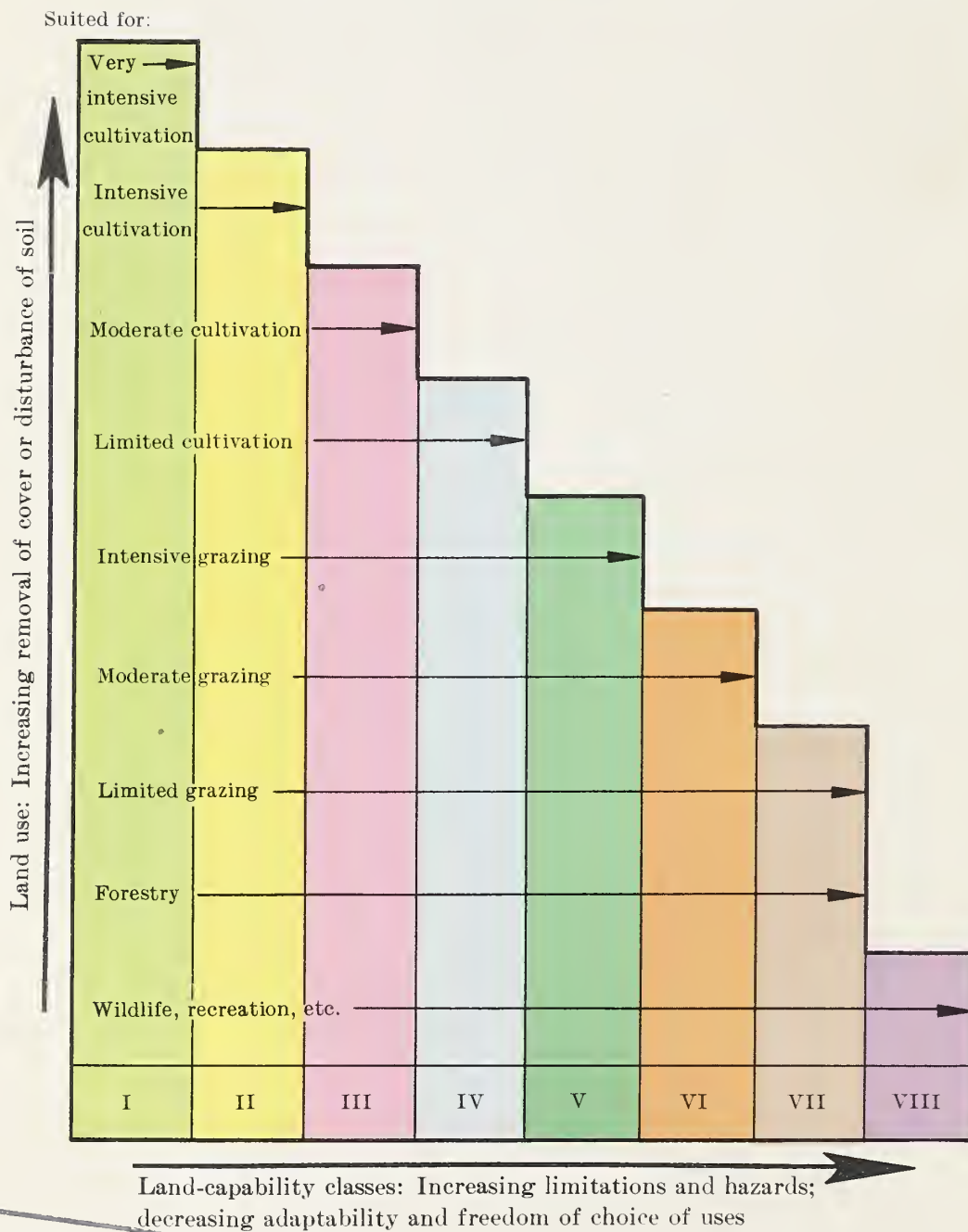
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SOIL CONSERVATION SERVICE
H. H. Bennett, Chief

SOUTHEASTERN REGION
T. S. Buie, Regional Conservator

LAND USE MAP
FOR: CHEROKEE SOIL CONSERVATION
DISTRICT, SOUTH CAROLINA

Work Unit: Cherokee County
Owner: Jonah Blackwell
and Elijah Blackwell
Address:
Operator:
Address:
Scale: 1" = 660'
Location: 10 miles northwest of
Gaffney on Chesnee Highway.

Relation of land limitations and land-capability classes to safe land use



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